ESO 1044

ANNUAL COSTS OF PRODUCING SPREADING DECIDUOUS SHRUBS (COTONEASTER) DIFFERENTIATED BY SIZE OF FIRM IN OHIO

By

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October 1, 1983

ABSTRACT

The objective of this study was to determine annual production costs for spreading deciduous shrubs in containers in Ohio differentiated by size of firm. This objective was accomplished by synthesizing two model container nurseries using the conceptual framework of economic engineering. Once the nurseries were synthesized, growing space was divided into five equal parts with each part being assigned a plant group. In the small container nursery, spreading deciduous shrubs were allocated 68,000 sq ft of growing space and 40,800 sq ft of polyhouse space. For the large nursery, the figures were 136,000 and 81,600 sq ft respectively. One specific species of spreading deciduous shrub, Cotoneaster, was chosen for detailed analysis. In the space allocated, 20,730 12-15 inch salable cotoneaster could be produced annually in the small nursery and 41,455 in the large. Total annual costs per salable plant were $5.04 in the small nursery and $4.56 in the large. These costs were based on 1982 figures and assumed a 2-year growing cycle with production in 2-gallon containers.

INTRODUCTION

Spreading deciduous shrubs including various species of Berberis, Cotoneaster, and Euonymus are important plants in Ohio container nursery production. Berberis t. 'Crimson Pygmy', for example, is a dwarf compact red-leaf plant that makes an attractive hedge or accent plant. Cotoneaster apiculata has a low growth habit, attractive pink flowers in the Spring and bright red berries in the Autumn that make it a very desireable deciduous ground cover. Euonymus alatus 'compacta', a low growing shrub has small green leaves in Summer and outstanding red foliage in Autumn. All of these plants are hardy once established, but require considerable overwinter protection in the nursery when produced in containers.

The specific objective of this study was to determine annual production costs for spreading deciduous shrubs in containers in Ohio differentiated by size of firm. This information should aid Ohio nurserymen in their decisions regarding which plants to grow and in what quantities.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model. They were synthesized based on the Columbus, Ohio area. The complete synthesis included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with the purchase of plant liners and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs (3).

Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1982. The basic goals in synthesizing the production facilities were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and keep future expansion possible. See Taylor et. al. (3) for a detailed analysis on the physical plant, production system, and capital and production budgets*. Kneen et. al. (1) provides a rather precise summary of capital requirements for establishing container nurseries in ohio.

The production system chosen for this analysis consists of utilizing husky two year old bareroot liners to produce a salable plant within two growing seasons. These 6-7" liners are transplanted directly into two gallon (8-1/2" x 8") copolymer containers during the month of May. Approximately 10% of the crop will be sold during the fall of the second growing season (approximately 18 months), 50% during March and April after the second growing season (approximately 22-23 months), and 10% during May after the second growing season (24 months). May is a period when clean-up sales are being made and new plants started. This production system saves transplanting as the plants are sold in the same containers in which they are started (two gallon).

A model facility was synthesized for both a small (340,000 sq ft of growing area) and a large (680,000 sq ft of growing area) container nursery. The nursery operations were assumed to produce a diverse line of nursery stock each having a two year production cycle. Commonly grown nursery

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stock was divided into five cultural groups. While not all inclusive, the groups do permit developing a range of per unit costs related to input costs and cultural factors. For analytical purposes, it was assumed that each cultural group would occupy 20% of the growing area (i.e. small nursery = 68,000 sq ft per group; large nursery = 176,000 sq ft per group). Costs developed on spreading deciduous shrubs (Cotoneaster) therefore were based on the scale of the complete nursery, but analyzed on the basis of of percent of total space occupied. A report on spreading evergreens (Juniperus) using equivalent 1982 data was previously published (2) while companion studies in this publication report on slow growing evergreens (Taxus), upright deciduous shrubs (Viburnum) and broadleaf evergreens (Rhododendron).

For detailed analysis on spreading deciduous shrubs, one specific plant type (Cotoneaster) was choosen. While it is recognized that other spreading deciduous shrubs would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the Cotoneasters analyzed. Among others, the category of spreading deciduous shrubs would include Berberis t. 'Crimson Pygmy', Cotoneaster apiculata, Cotoneaster horizontalis, Cotoneaster dammerii and Euonymus alatus 'compacta'. Some of their unique cultural characteristics would be hardwood bark medium and need for maximum overwinter protection.

Costs were established for all factors of production including management and invested capital. In economic terms, costs associated with factors of production inputted by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested in land, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nurseries were first determined (1). Second, capital requirements per salable plant capacity by spacing and size of nursery were established (3). Third, annual fixed costs were calculated (see companion study entitled "Annual Fixed Costs of Operating Container Nurseries in Ohio Differentiated by Size of Firm and Species of Plant"). Fourth, annual variable costs were determined for each of the two sized nurseries (Tables 1, 2 and 3). Fifth, summaries were made for annual fixed and variable costs for each of the plant groups according to size of nursery (Table 4). This allowed cost comparisons based on size of nursery.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. Analyses on a "cash" basis does not give a true economic picture of the cost of producing a plant as it does not take into account the time value of money from the time the plant is planted until it is harvested. The analyses do, however, give a true estimate of the annual cost per salable plant.

Total annual production costs consist of both fixed and variable factors. Fixed costs are primarily made up implicit costs such as depreciation on buildings and equipment, interest charges (both for borrowed and equity capital) and charges for management. Many nurserymen do not adequately consider fixed costs when computing costs of production. Fixed items are often considered as residual claimants on income. For example, management is compensated if all other factors of production have been accounted for. As noted previously, annual fixed costs are discussed in greater detail in a companion article.

Variable Costs

Variable costs include all cost factors that vary with the quantity of plants being grown at one point in time. Variable costs are explicit, obvious and normally paid out yearly. An example of variable costs is the number of liners required for spring planting which depends upon the quantity of plants management desires to have in inventory plus planting losses. A loss factor of 5% was assumed with 2 1/2% being taken in the first production year and 2 1/2% in the second. Variable costs were subdivided into the following categories: materials, machinery and equipment, labor, and interest on operating capital (Tables 1 and 2).

Containers. Container cost was the price of #2 containers plus freight which was estimated at 10 percent.

Soil mixture. A wide variety of growing media is used by nursery producers. While materials budgeted here would provide a good media for the plants under consideration, many producers may prefer a somewhat different mixture. Costs involved are for basic ingredients (sand, hardwood bark, soil, vermiculite, haydite, peatmoss), any added micro-elements, chemical additives for bark composting, fertilizers, and freight. All labor and equipment used in mixing or transferring to potting locations is included under labor hours and variable equipment and machinery costs.

Liners. Two costs compose the total for liners. The major cost is the purchase price. While price is somewhat

dependent upon quality and quantity, it was assumed that sufficient quality units would be ordered in either sized nursery to obtain them at the lowest possible cost. The second cost was for packing and shipping the liner from producer to purchaser. This was estimated at 10% of the purchase price. The size of liner purchased took into account the objective that each plant was to be grown in a 2 gallon container for two full growing seasons without becoming pot bound or over grown.

Polyethylene film. The cost of the film delivered to the nursery.

Thermal blankets. Thermal blankets were provided for overwintering. Thermal blankets were used in lieu of supplemental heat. Due to the cost of energy, supplementary heat is being phased out in Ohio. It was anticipated that the thermal blankets would be used for three seasons. An individual nurseryman could cut costs in this category if he could use the thermal blankets for additional seasons. Their costs were based upon the delivered price.

Strip tags. Strip tags are provided for identifying plants by botanical name, common name, state plant was grown in, and nursery producer. Costs include printing and shipping charges.

Chemicals. Chemical costs were subdivided into three cultural programs. The first is the herbicide, whose cost is the purchase price of the various pre-emergence and post-emergence materials. The second combines insecticide/miticide/fungicides used to control insect, mite and disease problems. Purchase price reflects total cost for the chemicals as local distributors were assumed. The third is fertilizer. For container operations the purchase price from local suppliers of both soluble and slow release reflect total cost.

Machinery and equipment. Variable machinery and equipment costs represent all costs incurred while equipment or machinery is in use. These costs are comprised of repair, fuel and lubrication/filter (Table 3). Repair cost per hour was calculated by multiplying initial cost by a stated repair percentage divided by the estimated lifetime use of the machinery in the large nursery in hours. The same repair cost per hour was used for both sized nurseries. Fuel costs were determined by multiplying units of fuel used per hour by the price per unit. Filter/lubrication cost was estimated at a constant factor of 15 percent of calculated fuel cost. Summation of repair, fuel and filter/lubrication costs result in total variable cost per hour of machinery or equipment useage. These costs were divided equally between the five plant groups making up the two nurseries.

Hourly labor. The following were included in determining total hourly labor charges: basic average hourly wage ($4.30), social security tax "FICA" (6.13% of basis), workmen's compensation (2.71% of basis), general health insurance (3.50% of basis), holiday and vacation pay (4.00% of basis), and unemployment insurance (3.4% for first $6,000 of a person's pay). The total hourly wage including all factors was budgeted at $5.15 per hour. Each major production activity was allocated necessary labor hours to accomplish assigned tasks. Since labor use was dependent upon the number of units produced, they were lower for those plant groups having the fewest number of salable plants.

Cost Summaries

After all cost factors were determined, they were summarized based upon cost per salable plant by size of nursery.

RESULTS AND DISCUSSION

Annual fixed, variable, and total production costs of producing spreading deciduous shrubs (Cotoneaster) in container nurseries in Ohio for 1982 are summarized in Table 4. In the small nursery, total annual costs were $104,524 or $5.04 per salable 12-15 inch plant. Fixed costs totaled $48,517 or $2.34 per plant and made up 46% of total costs. Based on a percentage of total costs, land and improvements made up 8%, buildings 10%, machinery and equipment 8%, general overhead 18%, and interest on general overhead, insurance, and taxes 2%. Variable costs totaled $56,007 or $2.70 per plant and made up 54% of total costs. Based on a percentage of total costs, materials made up 37%, machinery and equipment 4%, labor 9%, and interest on operating capital 4%.

In the large nursery, total annual costs were $189,005 or $4.56 per salable 12-15 inch plant. Fixed costs totaled $78,209 or $1.89 per plant and made up 42% of total costs. Based on percentage of total costs, land and improvements made up 9%, buildings 9%, machinery and equipment 7%, general overhead 16%, and interest on general overhead, insurance, and taxes 1%. Variable costs totaled $110,796 or $2.67 per plant and made up 58% of total costs. Based on a percentage of total costs, materials made up 41%, machinery and equipment 3%, labor 10%, and interest on operating capital 4%.

Total annual costs were 48 cents per plant more in the small nursery than in the large. Of this 48 cents, 45 cents or 94% were made up of fixed costs. On a per item basis, the large nursery's advantages were 1 cent on land and improvements, 10 cents on buildings, 12 cents on machinery and equipment, 20 cents on general overhead, and 2 cents on interest for general overhead, insurance and taxes. The 3 cents accounted for by variable costs was all accounted for by machinery and equipment. Variable costs for materials, labor, and interest on operating capital was the same for both sized nurseries.

In the nurseries analyzed, it cost 11% less to produce a 12-15 inch salable spreading deciduous shrub (Cotoneaster) in the large nursery than in the small. While the overall reduction was 11%, it was 24% for fixed costs and only 1% for variable. Large-sized commercial container nurseries are able to make more efficient use of buildings, equipment, and machinery than small container nurseries.

Individual nurseryment might well experience or at least calculate costs considerably different than those depicted here. Most cost differences would probably be reflected in fixed rather than variable costs. Most fixed costs are implicit and their full impact may not be calculated by established nurserymen. Budgets presented assumed new facilites, machinery, and equipment. Most nurserymen have owned their land for many years and have used machinery and equipment. For the established nursery, budgeted fixed costs on land improvements, buildings, machinery and equipment presented here would reflect replacement rather than 'book values' of depreciated items. Presented fixed costs also placed a market value on management. Many nurserymen place little if any value on their own management when computing costs. Variable items, on the other hand are explicit, experienced at least yearly, and easily accounted for. Variable costs presented here would be typical for the industry in Ohio and should be rather consistent regardless of age and size of the nursery.

SUMMARY

Total annual costs per salable spreading deciduous shrub (Cotoneaster) were $5.04 in the small nursery and $5.04 in the large. Fixed costs were $2.34 in the small nursery and $1.89 in the large for a differential of 45 cents per salable plant. Variable costs, on the other hand, were $2.70 in the small and $2.67 in the large for a differential of only 3 cents. These per plant costs assumed a 2-year growing cycle, production in 2-gallon containers and an average size of 12-15 inches per salable plant.

These figures demonstrated that variable costs on a salable plant basis, at least over the size range of nurseries analyzed, remain reasonably constant. The small nursery could purchase materials and other variable items almost as cheaply as could the large. Fixed costs in contrast changed significantly as size of nursery increased. This occurred because most of the fixed factors required to operate the small nursery such as management, buildings, and most machinery and equipment were also adequate to operate the large. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing the fixed cost per plant.

LITERATURE CITED

1. Kneen, Harold H., Reed D. Taylor, David E. Hahn, and Elton M. Smith. 1982. Capital Requirements for Establishing Container Nurseries in Ohio--1982. Ohio Agri. Res. and Dev. Ctr., Res. Circ. 274, Ornamental Plants--1983: A Summary of Research, pp. 3-8.

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TABLE 1.--Annual Variable Costs (Dollars) for Spreading Deciduous Shrubs (Cotoneaster) for a Small* Container Nursery in Ohio, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	21,820.00	6,328
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	174.56	5,411
Liners	2-year 6-7" liner	each	.85	21,820.00	18,547
Polyethylene film	4 mil white, 32' x 225'	each	107.00	10.20	1,091
Thermal blanket	4 - 1/4' 80' x 225' per house	each	775.00	1/3 (10.20)**	2,635
Strip tags	5/8" x 7" plastic strip tag	each	.02	20,730.00	415
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Metra-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	1.50	33
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	60.20	114
	Osmocote 8-9 mo (18-6-12)	pound	.86	3,425.58	2,946
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (Roundup) (herbicide)	quart	16.60	2.80	46
Subtotal					38,268
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15***	1,622.00	8,353
	Related labor hours	hour	5.15	324.40	1,671
Subtotal					10,024
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	53,868.00	4,040
Total Annual Variable Costs					56,007
Annual Variable Cost per 12-15 Inch Salable Plant					2.70

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space. Spreading Deciduous Shrubs, 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 20,730 12-15 inch salable plants per year.

**Thermal blankets would be used for three seasons.

***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 2.--Annual Variable Costs (Dollars) for Spreading Deciduous Shrubs (Cotoneaster) for a Larger Container Nursery in Ohio, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	46,635.00	12,654
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	347.08	10,760
Liners	2-year 6-7" liner	each	.85	43,635.00	31,090
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Thermal blanket	4 - 1/4" 80" x 225' per house	each	775.00	1/3 (20.40)**	5,270
Strip tags	5/8" x 7" plastic strip tag	each	.02	41,455.00	829
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Osmocote 8-9 mo (18-6-12)	pound	.86	6,850.00	5,891
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (herbicide)	quart	16.60	5.90	93
Subtotal					76,465
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15***	3,245.00	16,712
	Related labor hours	hour	5.15	649.00	3,342
Subtotal					20,054
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	106,597.00	7,995
Total Annual Variable Costs					110,796
Annual Variable Cost per 12-15 Inch Salable Plant					2.67

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Spreading Deciduous Shrubs, 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 41,455 12-15 inch salable plants per year.

**Thermal blankets would be used for three seasons.

***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 3.--Estimated Variable Cost per Hour of Use for Machinery and Equipment for Container Nurseries in Ohio, 1982.

Item Number	Item	New Cost (dollars)	Expected Life (years)	Estimated Annual Use: Small* Nursery (hours)	Estimated Annual Use: Large** Nursery (hours)	Estimated Cost per Hour of Use: Repairs*** (dollars)	Fuel**** (dollars)	Lubrication and Filter (dollars)	Total (dollars)
1	Tractor, 60 HP, front end loader	16,000	10	132.70	269.50	5.34	9.14	1.37	15.85
2	Tractor, 28 HP	6,025	10	258.35 ea	349.92 ea	1.55	2.93	0.44	4.92
3	Manure spreader, 130 bu.	2,135	10	43.00	87.40	1.58			1.58
4	Wagon, 4-wheel, self steer	2,300	10	259.23 ea	263.25 ea	0.53			0.53
5	Irrigation well & Pump-75 HP	40,085	20	735.00	1,002.50	0.20	5.61	0.84	6.65
6	Inground irrigation system*****	77,160	20	735.00	1,002.50	1.54			1.54
7	Above ground irrigation system*****	38,765	5	735.00	1,002.50	3.09			3.09
8	Fertilizer injector	6,500	5	120.00	180.00	4.33			4.33
9	Air blast sprayer	6,995	7	16.20	33.15	23.98			23.98
10	Cyclone spreader	40	-	12.40	25.40				
11	Forklift	24,000	10	129.84	264.00	5.45	0.99	0.15	6.59
12	Truck, 1/2 ton pick-up	8,000	5	375.00	375.00 ea	3.84	4.06	0.61	8.51

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.

**33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space.

***Repairs per hour were based on useage of the large nursery. They were computed on the basis of percent of new cost over the life of the asset. Percent factors used were: 90 for item numbers 1,2,and 12; 80 for item 9; 65 for item 3; 60 for items 4, 8, and 11; 40 for items 6 and 7; and 10 for item 5. The total was then divided by the estimated total number of hours the equipment would be used in the large nursery during the life of the asset.

****Fuel was estimated at $1.27 gallon for gasoline drived items, $0.27 per killowatt for electrical driven and $24.66 for L.P. tank gas.

*****Cost is for a large nursery on which variable costs per hour were based. Cost for the small nursery was lower.

Table 4.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) of Producing Spreading Deciduous Shrubs (Cotoneaster) in Containers in Ohio, 1982.

Item	Small Container Nursery*			Large Container Nursery**		
	Cost	Cost per Salable Plant	Percent of Total Cost	Cost	Cost per Salable Plant	Percent of Total Cost
Fixed Cost Items						
Land and Improvements	8,616	.41	8	16,436	.40	9
Buildings	10,190	.49	10	16,127	.39	9
Machinery and Equipment	9,129	.44	8	13,142	.32	7
General Overhead	19,005	.92	18	30,000	.72	16
Interest on General Overhead, Insurance, and Taxes	1,577	.08	2	2,504	.06	1
Subtotal	48,517	2.34	46	78,209	1.89	42
Variable Cost Items						
Materials	38,268	1.85	37	76,465	1.85	41
Machinery and Equipment	3,675	.18	4	6,282	.15	3
Labor	10,024	.48	9	20,054	.48	10
Interest on Operating Capital	4,040	.19	4	7,995	.19	4
Subtotal	56,007	2.70	54	110.796	2.67	58
Total Annual Costs	104,524	5.04	100	189,005	4.56	100

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
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